Airborne mapping and in situ validation of European land surface temperature using NASA-JPL's HyTES sensor

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1 Background

- Data acquired during joint NASA-ESA Temperature Sensing Experiment (NETSense), in support of proposed future European High Spatio-Temporal **Resolution Land Surface Temperature Monitoring (LSTM) mission**, a candidate future Sentinel satellite
- Aims of NETSense: address water, agriculture and food security issues by **monitoring the variability of land surface temperature (LST)**, and hence evapotranspiration, at the European field scale

Fig. 1: HyTES sensor being installed into the British Antarctic Survey (BAS) Twin Otter Plane

2 Method

- Field campaign conducted in Italy and UK in Summer 2019, with sites including farmland, a water stress experiment, urban areas and lakes
- Two sensors flown onboard BAS Twin Otter: NCEO's **hyperspectral VNIR-SWIR** sensor, AisaFENIX (380 – 2500 nm, 620 bands) and NASA-JPL's **hyperspectral LWIR imager** – the Hyperspectral Thermal Emission Sensor (HyTES; 7.5 – 12 μm, 256 bands)
- **In situ data was collected close to or coincident to the flights**, including surface spectral reflectances, surface spectral emissivities, radiometrically-derived surface temperatures, contact surface temperatures, evapotranspiration and atmospheric parameters including downwelling radiation
- Level 1 raw TOA radiances were processed to Level 2 **geo-corrected surface reflectances** (FENIX) or **land surface temperatures (LSTs) and emissivities** in all bands (HyTES)
- LSTs and emissivities were **compared against in situ values** to evaluate performance of the HyTES LST and emissivity retrieval algorithm

Fig 2: Example target surfaces around Grosseto, Italy

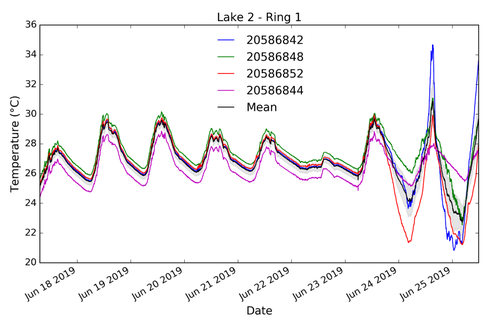


Fig. 3: Example lake surface temperature data from Grosseto, Italy

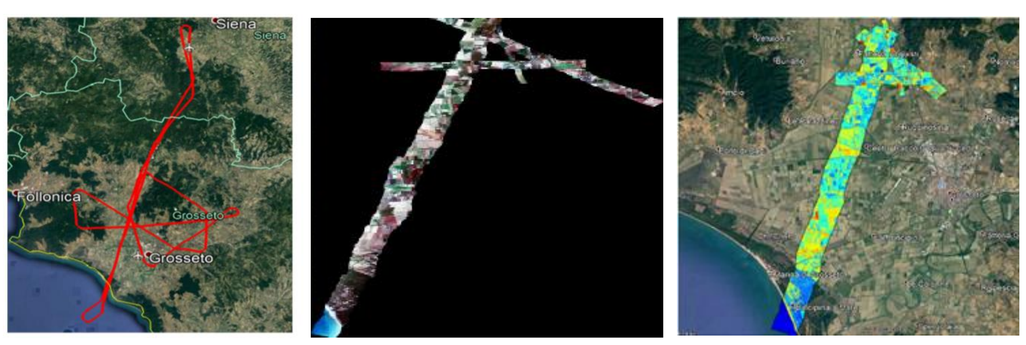
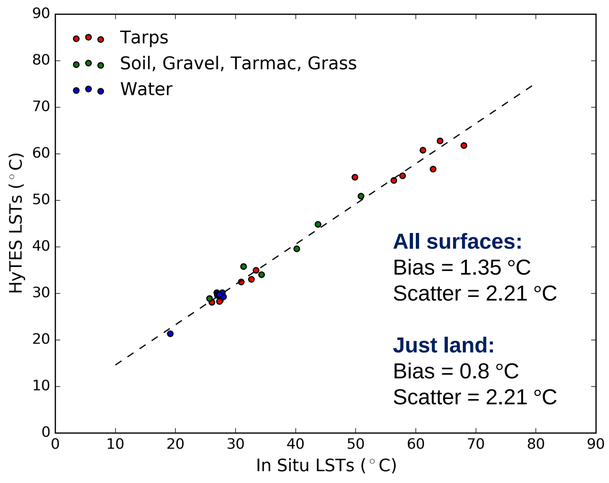


Fig 4: (i) Flight path over Grosseto, Italy (ii) L2 FENIX Reflectance (iii) L2 HyTES Land Surface Temperature

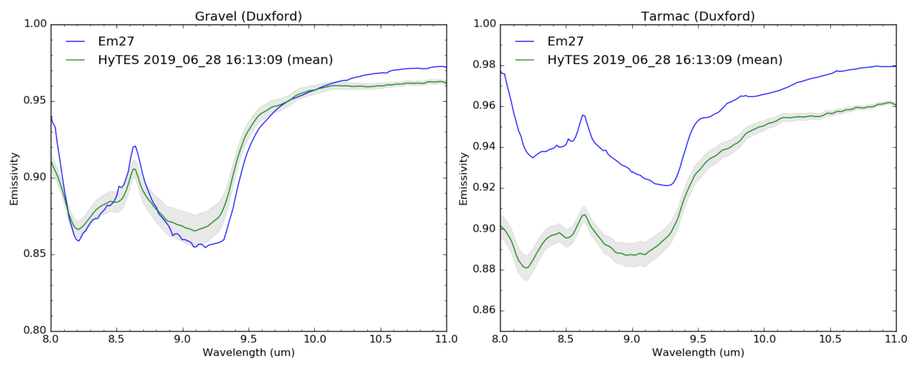
3 Preliminary Results

Land Surface Temperature



Emissivity

- Emissivity retrieval performance surface-dependent
- HyTES emissivities consistently lower than in situ 8 – 8.5 μm & > 11 μm



4 Future Work

- Finalise Level 2 processing of remaining few flightlines
- Uncertainties on all *in situ* measurements
- Finalise LST and emissivity comparison work
- Derive evapotranspiration from HyTES LST data and compare to *in situ* data from fluxtowers
- Use HyTES LST and emissivity to evaluate LSTs and emissivities from spaceborne estimates (Sentinel-3 SLSTR, ECOSTRESS, MSG-SEVIRI)

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Want more info?

Further information on the NETSense campaign is available at https://tinyurl.com/ydchdklw and through the QR code.